AMENDED SPECIFICATION

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PATENT SPECIFICATION

708,342

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COMPLETE SPECIFICATION

Improvements in method of and apparatus for the Continuous Production of Flat Homogeneous, or Stratified Materials

We, DYNAMIT - ACTIEN - GESELLSCHAFT VORMALS ALFRED NOBEL & Co., of Troisdorf, District of Köln, Germany, a Joint-Stock Company organised under the laws of Germany, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

The invention relates to a method of and apparatus for the continuous production of preferably flat, homogeneous, or stratified materials in the form of sheets, foils, bands, strips, or ribbons, and also of workpieces having simple flat bounding surfaces, of synthetic fibres or synthetic plastic masses, with or without fibrous chip-like or pulverulent filling substances of organic or inorganic origin, and also of hydrated cellulose, by compression, if desired with simultaneous or subsequent deformation by the application of heat and pressure.

The invention further relates to the continuous treatment of such materials for the purpose of surface improvement by polishing, matting, stamping, smoothing, coating, or bonding between heatable and/or coolable, preferably plate-shaped tools.

It has already been proposed to carry out such treatment of flat materials in the form of endless lengths in heatable presses kept under a constant pressure. For this purpose the material is passed between caterpillar chains incorporating heatable plates. This method of working has the disadvantage that the press members must be of very heavy construction, because they must take pressing pressures of 50 to 100 kg. per square centimetre, and because considerable forces are necessary for the transportation of the flat materials held under this pressure. In such apparatus, on the one hand, the material is subjected to very heavy stresses, while on the other hand it works unfavourably from the point of view of heat economy, since large masses of metal have to be alternately heated and cooled within short intervals of time.

It is an object of the present invention to obviate the foregoing disadvantages by providing a method wherein the material to be treated is subjected by the press plates to pressure impulses of short duration on passing between said plates. It has in fact been found in experiments that for materials which cannot be finished on rollers a constant surface pressure is not necessary but that this pressure may be pulsating. In the latter case, however, the material may be drawn through between the pressing plates in a simple manner, by means of two thin endless bands or belts of steel or other suitable material, during the intervals of time in which no pressure, or only slight pressure, is applied. Given a material which is not sticky and which coheres sufficiently firmly, even these bands may be dispensed with.

These thin bands are conveniently in the form of endless conveyor belts guided over rollers, and may if desired have profiling,

[*Price 3s. 0d.*]

stamping, matting, polishing, or other surface finishes suitable for the particular purpose required. However, it may in some cases be advantageous to insert between the conveyor belts and the material to be treated a separate band or tool for effecting the required stamping, profiling, polishing, or matting; if desired, the tools may be passed through without the conveyor belt. Both bands and tools are made of materials having good thermal conductivity, for example aluminium, bronze, nickel, or steel. In the method according to the invention, the heating and cooling plates are stationarily mounted in the press column, so that the material with the thin bands is guided as a transmitter of heat from the heating zone into the cooling zone, so that only the heat in the band itself is lost.

In order to obtain a uniform product by the present method, it is necessary to work with short feed movements and short pressure intervals. These working conditions, however, require a relatively rapid alternation of pressure, which in conventional presses cannot be obtained on account of their great mass and the consequent inertia. It is a further object of the invention to obviate this difficulty by working the method hydraulically, preferably with small strokes, while in consequence of these small strokes the masses themselves, and the forces required for their acceleration, can be kept low. This method of working not only enables the high specific pressures (for example of 50 to 100 kg. per sq. cm.) to be obtained by simple means, but it has also the further advantage that only relatively small masses have to be accelerated in the production of the high speed pressure impulses of 60 to 300 per minute.

It is a still further object of the invention to provide an apparatus for carrying out the foregoing method. One embodiment of apparatus consists in the provision of one fixed, heatable and coolable pressing plate and, at a distance therefrom, a reciprocable, heatable and coolable pressing plate, the latter plate being moved intermittently towards the fixed plate by a pulsating hydraulic pressure. However, both the upper and lower pressing plates may be made reciprocable and be moved intermittently towards one another by pulsating hydraulic pressure, while the distance between the two plates, if necessary, can be maintained by resilient means, for example springs.

The production of the pulsating hydraulic pressure, and also the transmission of the pressure to the heatable and coolable pressing plates, can take place in any desired manner. An advantageous solution of the problem consists, according to a feature of the apparatus of the present invention, in disposing against one or both pressing plates a hollow space filled with a hydraulic fluid, preferably closed off by a diaphragm, which is in communication with a driving member consisting of cylinder and piston and generating pressure impulses of short duration.

It has been found that it is not necessary in all cases to transmit the hydraulic pressure, which is expressed in the movements of the diaphragm, through heatable and/or coolable pressing plates. According to the present invention, on the contrary, the pressing plates may be dispensed with and the pulsations of the diaphragm may be caused to act directly on to the material to be treated. This measure constitutes a great simplification in the mechanical construction of the apparatus and also a substantial saving in power, as the accelerating forces for the heavy pressing plates are eliminated. Since the working zone is limited on the one hand by the diaphragm and on the other hand by a stationary heatable and/or coolable pressing plate, in this arrangement heating and/or cooling of the material can be carried out if required, whereby the liquid would assume through the diaphragm a mean temperature.

In most cases, however, it will be more advantageous if, in a further development of the principle of the present invention, the pressure space above the diaphragm is subdivided by a partition into heatable and coolable chambers, each of which can have a separate drive for the generation of pulsating pressure, in such manner that the heated pressing plates lie opposite the heated chambers and the cooled pressing plates opposite the cooled chambers. The partition may, for example, be constructed as a labyrinth packing.

However, according to a further feature of the invention, the fixed heatable and coolable pressing plates may also be eliminated, pressure chambers subdivided into heatable and coolable chambers being provided on both sides of the material to be treated, the closing diaphragms of which chambers bear directly on the material or the conveyor belt and transmitting both the pulsating pressure and the temperatures necessary for the particular treatment.

When working at very high pressures, the thin diaphragms are subjected to very great mechanical stresses. In these cases, therefore, it is proposed according to the present invention to close the liquid container acted on by pulsating pressure actions by one or more preferably plate or mushroom shaped pistons which act on the material to be treated. In this arrangement the pistons may lie only on one side, and act against a fixed counter-plate; they may however be provided on both sides and act against one another.

When treating very thin sheets or foils, preferably below 0.5 mm., an equalisation in the transmission of pressure is, however, necessary in consequence of the irregularity of the material, for which reason, in order to improve

still further the apparatus of the present invention, there are disposed on the one pressure side one or more pistons acted on by pulsating hydraulic pressure, and on the other pressure side one or more diaphragms which are under pulsating hydraulic pressure or may be constructed as cushions. When they are constructed as cushions, the closed hollow space behind the diaphragm is filled with a pressure equalising means, for example grease, which uniformly distributes the pressure over the diaphragm. Instead of this, however, the head of the pistons themselves may advantageously be constructed as a diaphragm. In all cases, on the side, facing away from the diaphragms, there are preferably also provided heatable and/or coolable pressing plates, between which the material is passed through. Instead of the hollow space or hollow spaces with closing diaphragm, disposed on the one side, according to the present invention use may also advantageously be made of a likewise heatable or coolable roller, which runs beneath the diaphragm and thereby facilitates the feeding of the material, or in many cases either makes the conveyor belts entirely unnecessary or permits the use of very thin conveyor belts of a material having good heat conducting properties, particularly metal foils. In these cases the diaphragm is given a concave shape corresponding to the curvature of the roller, so that it bears uniformly on the surface of the roller and transmits the same pressure at all points.

The use of a roller, preferably at the lower pressure side, provides certain advantages, particularly in the production and surface treatment of thermoplastic materials. These materials are generally worked up on roll calenders. In such cases however the transmission of pressure and also the heating action take place for a short time only in the region of the line of contact between the roll surfaces. The time for the permanent compression and/or deformation of the materials is insufficient when using calenders. On the other hand, however, the use of rolls in the continuous working up of mouldable substances affords a number of known advantages. The utilisation of these advantages, while eliminating the above mentioned disadvantages, is however made possible by the apparatus of the present invention.

Instead of allowing the diaphragm to bear directly on the material, it may be advantageous, according to a further feature of the present invention to dispose above the heatable or coolable roller a plate-shaped heatable and/or coolable pressing tool driven by pressure impulses, and which has, on the side facing the surface of the roller, a concave surface curved concentrically with respect to the centre of the roller, in such a manner that this plate covers a roller sector of less than 180°. Since the roller itself acts as conveyor means, a separate conveyor belt can, in most cases, here again be dispensed with, particularly as both the roller and the pressing tool can be used, by suitable shaping of the surface, direct for surface treatment. According to requirements, a plurality of such pressing tools can be provided, distributed along the periphery of the roller, and thus further working zones provided, while, for example, the material may be preheated and pre-compressed in the first working zone, after-compressed and, if desired, hardened out, in a second zone, and cooled in a third working zone.

According to a further feature of the invention, a combination of mechanically and hydraulically generated pressure impulses permits more general application of the apparatus in the treatment of the most diverse materials. Thus, for example, through a lower, mechanically operated pressing plate the stroke movements necessary for the treatment or compression of the material, and which in part are considerable, can be produced, whilst by means of a diaphragm which is under pulsating hydraulic pressure the high pressing pressures can be applied. The diaphragm, the maximum permissible deflection of which is naturally small, can thus be used for its actual task of transmitting high pressures. It is further possible to transmit pressure impulses of high frequency through the diaphragm and pressure impulses of lower frequency through the mechanical arrangement, and to apply these simultaneously.

Further features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings, which illustrate diagrammatically and by way of example several embodiments of apparatus for carrying out the method of the present invention, and in which:—

Figure 1 is a longitudinal section taken along the line b—b of Figure 2, through a press having pulsating hydraulic pressure;

Figure 2 is a cross-section along the line a—a of Figure 1;

Figure 3 is a longitudinal section along the line c—c of Figure 4 of a press having flat pressing surfaces and having liquid chambers separated from one another;

Figure 4 is a cross-section on the line d—d of Figure 3;

Figure 5 is a vertical longitudinal section through a press having a pulsating, solid-walled piston;

Figure 6 is a vertical longitudinal section through a press in which the base of the pulsating piston is constructed as a diaphragm.

Figure 7 is a vertical longitudinal section through a press along the line e—e of Figure 8, in which pulsating pressure is provided on both sides;

Figure 8 is a vertical cross-section along the line f—f of Figure 7;

Figure 9 is a cross-section through a press having curved pressing surfaces;

Figure 10 is a longitudinal section through a press in which the lower pressure plate is formed by a roller, while the upper pressure plate has a concave shaping corresponding to the surface of the roller;

Figure 11 is the side view of a press of the type illustrated in Figure 10, in which three press devices are provided along the periphery of the surface of the roller;

Figure 12 is a longitudinal section through a press in which a lower heatable and coolable press plate is mechanically reciprocated.

On a bed frame 1 (see Figures 1 and 2) rest a heating plate 3 and a cooling plate 4 with an interposed heat insulating layer 2. The bottom part 1 of the frame is connected to the upper part 5 of the frame by distance-regulating spacer bolts 6. The upper part 5 of the frame encloses a hollow space 7 to hold a liquid, said hollow space in turn being in communication with a cylindrical space 8 in which a piston 9 generates the hereinbefore referred to pulsating pressure through a crank drive 10. On the side facing an upper heating plate 11 and a cooling plate 12, the hollow space 7 is closed by a diaphragm 13, e.g. a stiff elastic metal such as steel or bronze. The pressing pressure is transmitted by means of the liquid (oil) to the diaphragm 13, and further transmitted through an intermediate plate 14 with heat insulation 15 to the upper heating and cooling plates. Endless belts 18 and 19, guided over rollers 16 and 17, convey the flat material 20 to be treated through the press. Rollers 16 are driven intermittently in known manner, for example through a spring transmission. The heating and cooling plates are kept at a distance from each other by compression springs 21.

In the embodiment of press illustrated in Figures 3 and 4, heating and cooling pressing plates 22, 23 are stationarily mounted on the lower part of the frame (not shown). In the upper part 24 of the frame are provided hollow spaces 25 and 26 to receive a liquid. These hollow spaces are closed by a common diaphragm 27 in the direction of the lower pressing plates. On the upper part 24 of the frame are provided cylindrical extensions 28, in which pistons 29 are reciprocated in order to generate the pressure impulses. These pistons are driven by crank drives 30 and gear wheels 31. The material to be treated (not shown) is passed through the machine in the gap beween the bottom pressure plates 22 and 23 and the diaphragm 27. If treatment at different temperatures is required, the pressing plates 22 may, for example, be heated and the pressing plates 23 cooled. The liquid located above the plates in the hollow spaces 25 and 26 will then likewise be correspondingly heated and cooled, respectively. For the heating and cooling, heating and cooling coils 32 and 33 respectively are provided. In the cross-piece of the upper part of the frame, which separates the two liquid chambers from one another, a labyrinth packing 34 is provided, in order to prevent the passage of the liquid from the one space into the other, and thus to prevent an equalisation of temperature. If desired, the diaphragm arrangement may be repeated below the material in place of the plates 22 and 23.

In the embodiment of press illustrated in Figure 5 the lower part 36 resting on the bed frame 35 is constructed as a cylindrical body, in which a solid-walled piston 38, provided with a packing 37, is caused to perform oscillating movements, under the pulsating pressure of the liquid 39. Above the oscillating piston are disposed the heating plates 40 and the cooling plates 41, with the interposition of an insulating layer 42. The insulating layer may consist of an insulating material, for example asbestos, but may, if desired, be a metal plate having as low as possible thermal conductivity. The upper part 43 of the machine is likewise provided with heating plates 44 and cooling plates 45. Between these heating and cooling plates the material 46 is passed through by means of conveyor belts 48 driven through rollers 47.

In the embodiment illustrated in Figure 6, heating plates 50 and cooling plates 51 are provided only in the upper part 49, while the base surface 52 of the oscillating piston 53, constituted as a diaphragm, bears directly on the material 54 to be treated. This piston 53 is guided in the cylindrical lower part 55 and is under the pressure of the pulsating liquid 56, packings 57 being provided on the piston to prevent the latter from escaping. The material 54 is passed between the heating and cooling plates, on the one hand, and the piston on the other hand, by means of the conveyor belts 59 driven through rollers 58.

In the embodiment illustrated in Figures 7 and 8, the material 60 to be treated is subjected to pulsating pressure or thrust impulses on both sides. For this purpose, there are provided in the upper, stationary pressure piece 61 two chambers 62 and 63 filled with a hot liquid and with a cold liquid, these chambers being closed against the material by a diaphragm 64, while the chamber containing the hot liquid is separated by a labyrinth packing 65 from the chamber containing the cold liquid. The lower part 66 is constructed as a cylindrical container, which is closed by piston 68 provided with packings 67. On this piston, which is caused to oscillate by the pulsating liquid pressure, lie heating plates 69 and cooling plates 70. These plates are separated from pressure piece 61 by means of springs 71. Through the pipes 72 and 73 the upper and lower pressure chambers are in communication with a pump

(not shown), by which the pulsating pressure is generated in the upper chambers and chamber 74 filled with liquid. The material 60 is in turn passed through the machine by means of the conveyor belts 76 driven by rollers 75.

In the construction of press illustrated in Figure 9, the bottom pressing surface consists of a rotatably mounted roller 77, which, if desired, may be heated or cooled, and over which a diaphragm 78 is so stretched that it bears uniformly on the surface of the roller. In addition, this diaphragm closes a heatable or coolable hollow space 79 which is filled with a liquid and which is provided in the upper frame member 80. On this upper frame member is provided a cylindrical extension 81 to hold a piston 82 which generates the pulsating pressure impulses. The piston is in turn driven by a crank drive 83. The material 84 to be treated is guided by means of rollers 85 through the working chamber bounded by the roller 77 and the diaphragm 78.

In the construction of press illustrated in Figure 10, the bottom pressing tool consists of a roller 86 and the upper pressing tool of a plate shaped pressure body 87, the surface of which facing the roller is concave in shape, so that it bears completely against the latter and subtends an angle of less than 180° at the centre of the roller 86. Both roller and pressure body may, if desired, be heated by means of built-in heating elements 88 and 89, or cooled. In the upper part 90 of the press is once again provided a hollow space 91 to hold the liquid, which is set in oscillating motion by a piston 92 with the aid of a crank drive 93. These pressure impulses are transmitted through a diaphragm 94 to an intermediate plate 94*a* and from the latter to the pressure body 87. Between this pressure body 87 and the roller 86 the material 95 is passed through with the aid of the rollers 96.

In the arrangement illustrated in Figure 11, three pressing devices 98, 99, and 100 (similar to that shown in Fig. 10) are distributed around the periphery of a roller 97. Each pressing device is driven synchronously by a crank drive 101, in order that the pressure impulses of the three devices may in each case coincide in respect of time. The material 102 is passed by means of rollers 103 on to and off the pressing roller 97.

In the construction illustrated in Figure 12 the upper heatable and coolable pressing member is constituted by a diaphragm 120, which constitutes the closure member of hollow spaces 121 which are under pulsating liquid pressure. These hollow spaces are enclosed by the upper frame part 122 and are in communication with cylindrical spaces 123, in which the pulsating pressure impulses are generated by pistons 105 driven by oscillation generators 104. Bottom heatable and coolable pressing plates 106, 107 are caused to perform oscillating movements by means of a plate 108 and drive 109, through bars 110 which bear on the one hand against an intermediate cross-piece 112 guided on spacing bolts 111 and on the other hand against a lower cross-piece 113, while the bottom pressing plates 106, 107 are raised and lowered in rhythm with these oscillations.

The method of the present invention is suitable both for the continuous production and for the continuous surface treatment of stratified substances, from lengths of fibrous material or fabric impregnated with thermo-setting synthetic resins. Stratified woods, light plywood and the heavy hard wood, Lignofol, can also be produced by the method from wood veneers with interposed synthetic resin cement films in a continuous operation. In addition, the method permits, with excellent results, the production and treatment of endless sheets, lengths, bands, foils, strips, profiles, and shaped pieces of thermoplastic synthetic materials, such as vinyl resins, compounds comprising cellulose derivatives, polyamides, polyvinyl polymers, polyesters, and the like, with or without the addition of fibrous materials, mineral fillers, and emollients, as well as of leather, textiles, paper, and so on.

Loosely poured substances, such as cuttings granular materials, and fibre fleeces may also be compressed and hardened by the method, with thermoplastic compounds or with hardenable synthetic resins as binders.

Another field of application for the method is the production of simple flat bodies such as buttons, strips, and other objects having a height which is low in relation to extension, by hot pressing in moulds. In particular, this includes the pressing of gramophone records between steel matrices, which are passed through beneath the pressure plates by means of endless belts.

The essential advantages of the new method and of the relative apparatuses consist in the continuous method of working and the production of endless products, whereas hitherto it was only possible to produce sheets, in the elimination of the great losses of heat existing in known machines through the alternate heating and cooling, and in the possibility of pre-heating the individual lengths before treatment according to the invention in the pressing apparatus, so that the material is uniformly preheated and need merely be kept at its temperature. Thus, for example, a plurality of lengths of cellulose or fabric impregnated with synthetic resins can be continuously united to form hard papers or lengths of hard tissue, in the heated press, given suitable preheating which initiates the reaction, accompanied by hardening out of the condensation products, and thus, *inter alia*, endless hard paper foils such as are required for the construction of condensers can be

produced. In the same way it is possible to treat or to manufacture articles, which hitherto could be treated or manufactured with known pressing machines only with difficulty or not at all, such as long mats with or without a pattern, conveyor belts, endless polished foils, and so on of synthetic resin.

We are aware of Patents Nos. 574,354 and 657,293 and make no claim to anything claimed therein.

What we claim is:—

1. A method of continuously treating flat materials, containing or consisting of synthetic resin, to smooth the material or subject it to heat and pressure, characterised in that the material to be treated on passing between pressing plates or tools, is subjected to pulsating pressure or thrust impulses of short duration transmitted to the pressing members on at least one side of said material by a hydraulic fluid.

2. Method as claimed in Claim 1, wherein the pulsating pressure is applied to some of the pressing members by mechanical means.

3. Method as claimed in either of the preceding claims, wherein the material to be treated is intermittently fed between the pressing members by cooperating endless conveyor belts.

4. Method as claimed in Claim 3, wherein at least one of said conveyor belts is provided with a surface finish adapted to impart a predetermined finish to said material to be treated.

5. Method as claimed in Claim 3, wherein at least one surface treating member, adapted to impart a predetermined finish to the material to be treated, is inserted between at least one of said conveyor belts and said material.

6. An apparatus for continuously producing and treating flat materials by compression between pressing members at least one of which includes heat exchanging means, characterised by mounting at least one of said pressing members for reciprocating movement relatively towards and away from said other pressing member, only means for feeding said material to be treated between said members, and means associated at least with said first-mentioned member for generating hydraulic pressure impulses of short duration and transmitting them to said pressing members and to said material therebetween.

7. Apparatus as claimed in Claim 6, wherein the pulsating pressure generating and transmitting means comprise a hollow space in communication with at least said first-mentioned pressing member, a hydraulic fluid in said hollow space, and a cylinder and a piston, constituting driving means, in communication with said fluid for generating pressure impulses of short duration.

8. Apparatus as claimed in Claim 6 wherein the pulsating pressure generating and transmitting means comprise a hollow space adjoining at least said first-mentioned pressing member, a diaphragm closing said hollow space and in contact with said pressing member, a hydraulic fluid in said hollow space, and a cylinder and a piston, constituting driving means, in communication with said fluid for generating impulses of short duration, said impulses being transmitted to said pressing member by said diaphragm.

9. Apparatus as claimed in any of claims 6 to 8, wherein resilient means are provided for holding said members spaced from one another to provide a gap for the material to be treated.

10. Apparatus as claimed in Claim 8, wherein the said diaphragm means act directly on the material to be treated.

11. Apparatus as claimed in claim 7, which further includes heatable and coolable pressing members wherein the hollow space is subdivided by a partition into heatable and coolable chambers, each chamber having a separate pressure impulse generator, said heatable chamber lying opposite the heatable pressing member and said coolable chamber lying opposite the coolable pressing member.

12. Apparatus as claimed in any of Claims 8 to 10, wherein the hollow space is provided on both sides of the material to be treated, each space being closed by diaphragm means and subdivided by partitions into heatable and coolable chambers having separate pressure impulse generators.

13. Apparatus as claimed in any of Claims 7 to 12, wherein the hollow space is closed by a piston in contact with the first-mentioned pressing member, through which piston the pulsating pressure of short pulse duration is intermittently transmitted to the pressing members and to the material therebetween.

14. Apparatus as claimed in Claim 13, wherein said piston constitutes the first-mentioned pressing member.

15. Apparatus as claimed in Claim 13 or 14, wherein the head of the piston is constructed as a diaphragm.

16. Apparatus as claimed in Claim 6, which includes means associated with the first-mentioned pressing member comprising at least one hydraulically-actuated piston adapted to transmit a pulsating pressure intermittently to said pressing member and to the material to be treated, and at least one hydraulically cushioned diaphragm associated with the other pressing member.

17. Apparatus as claimed in Claim 16, wherein the piston and the diaphragm respectively constitute the pressing members.

18. Apparatus as claimed in Claim 6, wherein one of the pressing members is constituted by a roller and the other of said members is constituted by a diaphragm subjected to pulsating hydraulic fluid pressure, the material to be treated being adapted to be fed between said diaphragm and said roller by intermittent

rotation of the latter.

19. Apparatus as claimed in Claim 18, wherein the diaphragm bears uniformly on the surface of said roller.

20. Apparatus as claimed in Claim 6, wherein one of the pressing members is constituted by a roller and the other of said members is constituted by a plate-shaped heatable and coolable pressing tool subjected to pulsating hydraulic fluid pressure, said tool having on the side facing said roller a surface curved concentrically with respect to said roller but extending less than 180° thereover, the material to be treated being adapted to be fed between said roller and said curved surface by intermittent rotation of said roller.

21. Apparatus as claimed in Claim 20, wherein a plurality of said pressing tools are arranged around the periphery of said roller.

22. Apparatus as claimed in Claim 6, wherein mechanical means are used for generating the pulsating pressures of shore pulse duration and transmitting said pressures intermittently to the pressing members on one side of the material and to the material therebetween.

23. Apparatus as claimed in Claim 22, wherein said mechanical means comprise a member parallel to and spaced from the first-mentioned pressing member, means for reciprocating said member in a direction parallel to said pressing member, a plurality of levers rockably mounted at their ends between said pressing member and said reciprocating member, whereby on movement of said reciprocating member said levers are rocked from an inclined to a vertical position and back again, to cause said pressing member to move intermittently towards and away from said other pressing member.

24. Apparatus as claimed in either of Claims 22 and 23 wherein the mechanical means are associated with the first-mentioned pressing member, and a diaphragm actuated by an hydraulic fluid constitutes the other pressing member, a cylinder and a piston communicating with said fluid for generating pressure impulses of short duration in said diaphragm.

25. The method of continuously producing and treating flat materials substantially as herein described.

26. Apparatus for continuously producing and treating flat materials substantially as arranged and adapted to operate substantially as herein described and with reference to the accompanying drawings.

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708,342 AMENDED SPECIFICATION
5 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEET 1

Fig. 1

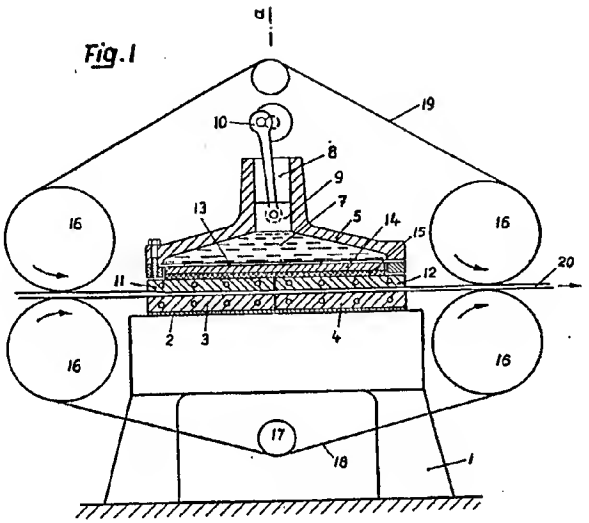

Fig. 2

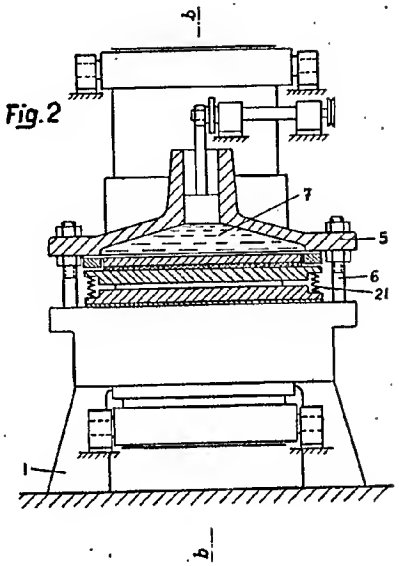

Fig. 3

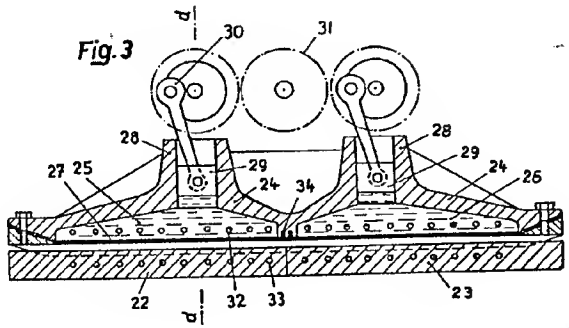

Fig. 4

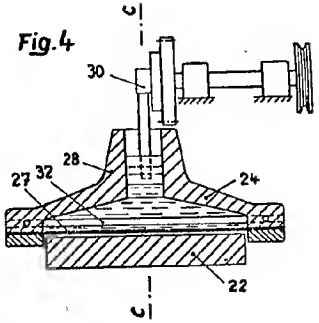

Fig.1

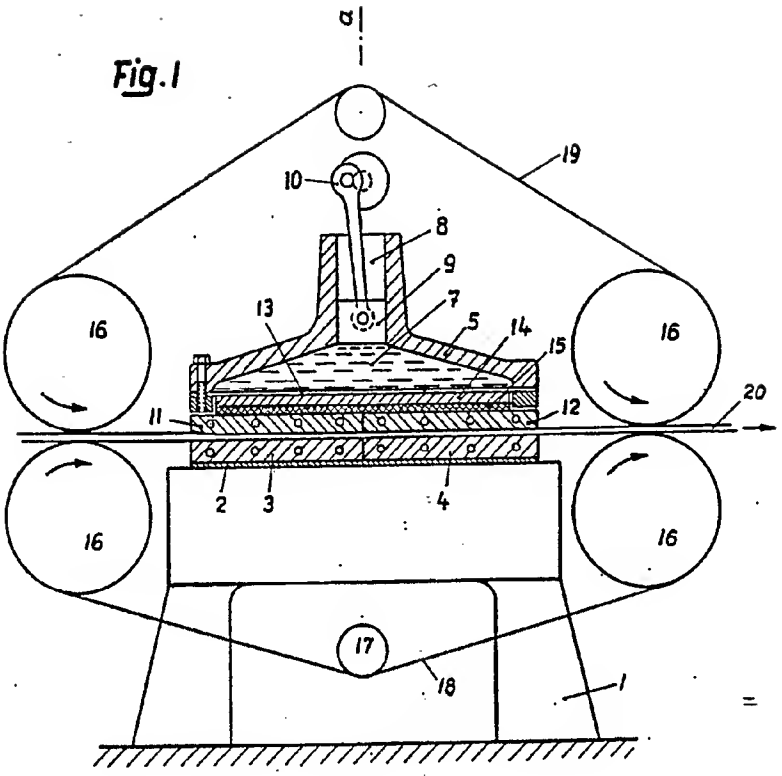
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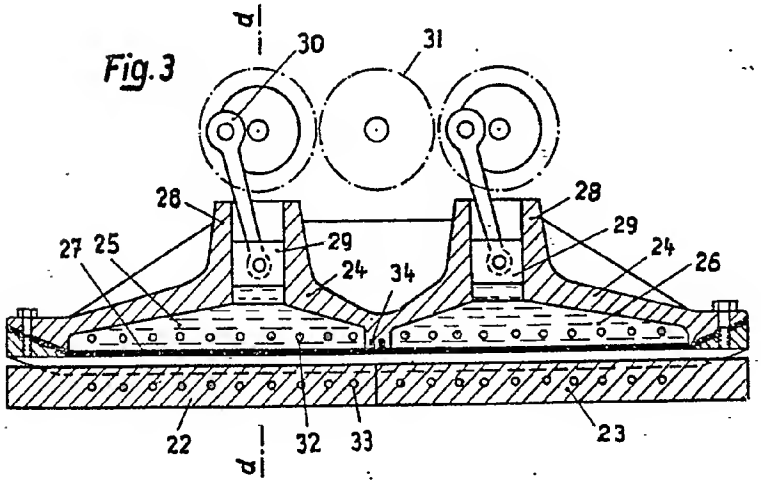
Fig.3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708,342 AMENDED SPECIFICATION
5 SHEETS
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SHEET 1

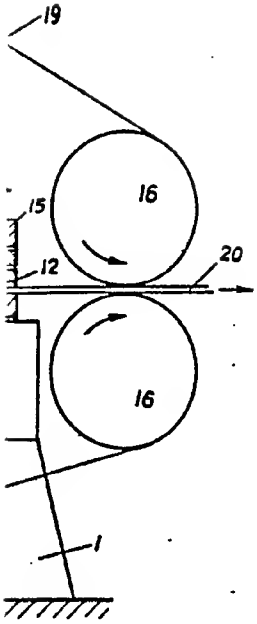
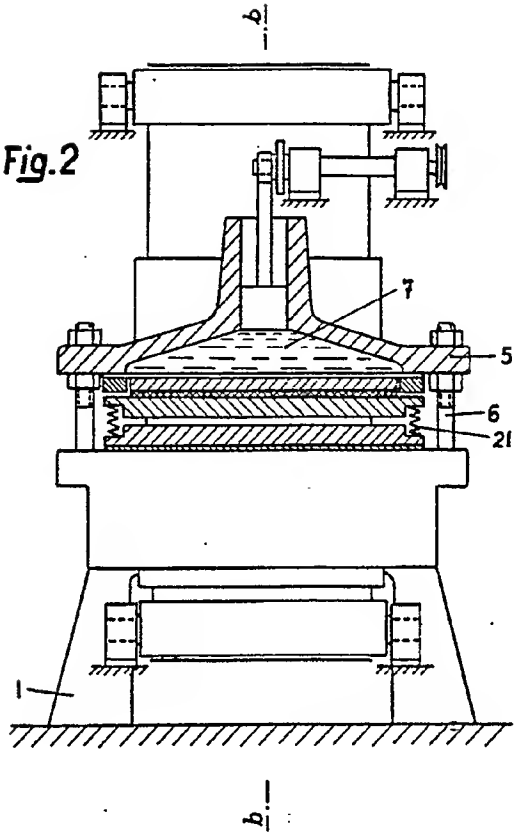


Fig.2



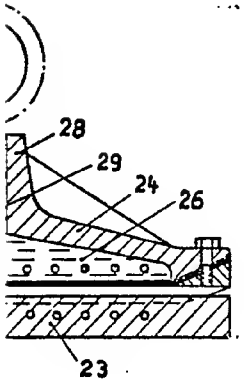
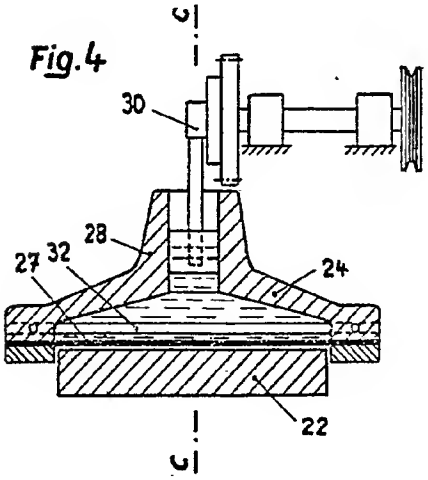


Fig.4



708,342 AMENDED SPECIFICATION
5 SHEETS
This drawing is a reproduction of the Original on a reduced scale.
SHEETS 2 & 3

Fig. 5

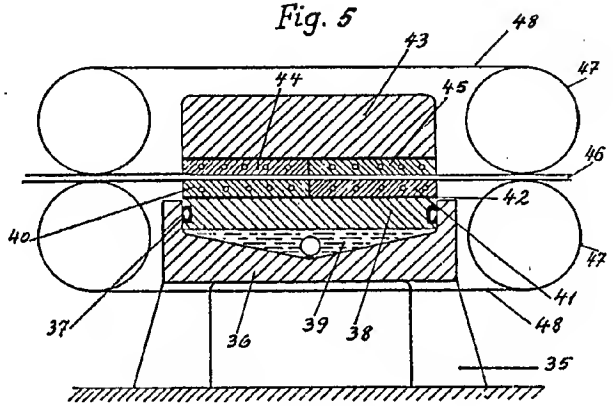


Fig. 6

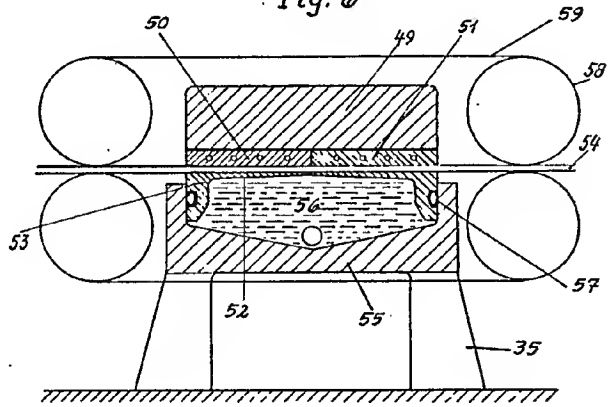


Fig. 7

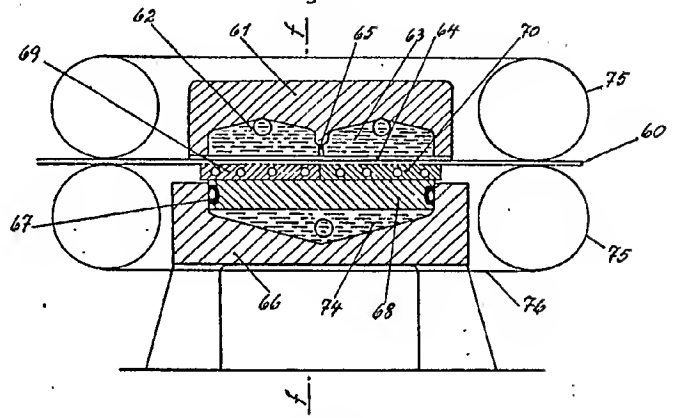


Fig. 8

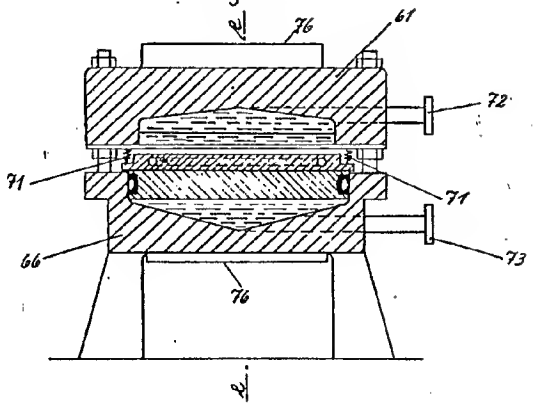


Fig. 5

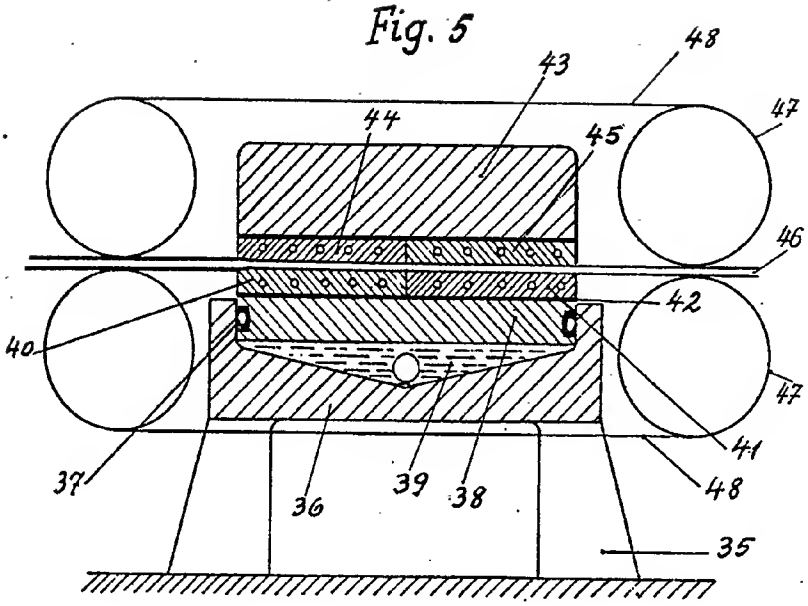

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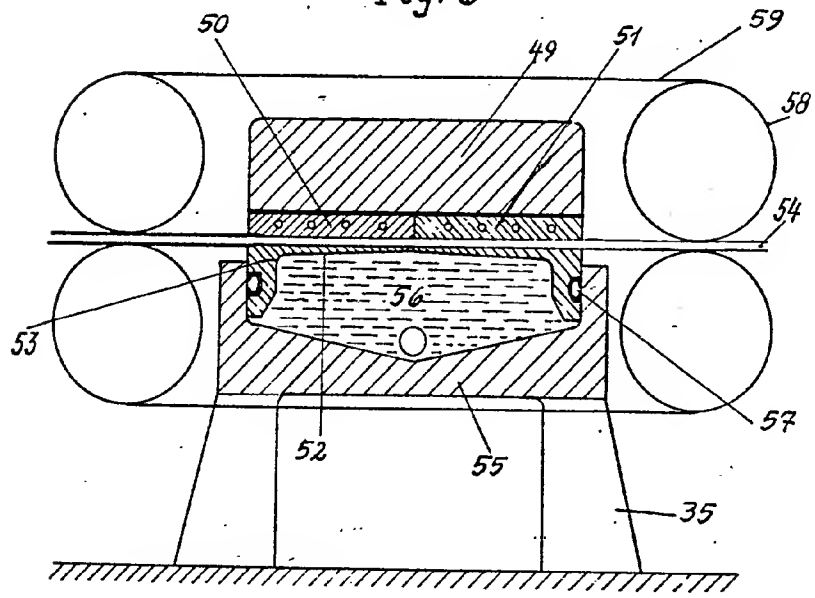
Fig. 6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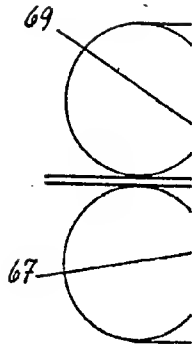
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708,342 AMENDED SPECIFICATION
5 SHEETS This drawing is a reproduction of the Original on a reduced scale.
SHEETS 2 & 3

Fig. 7

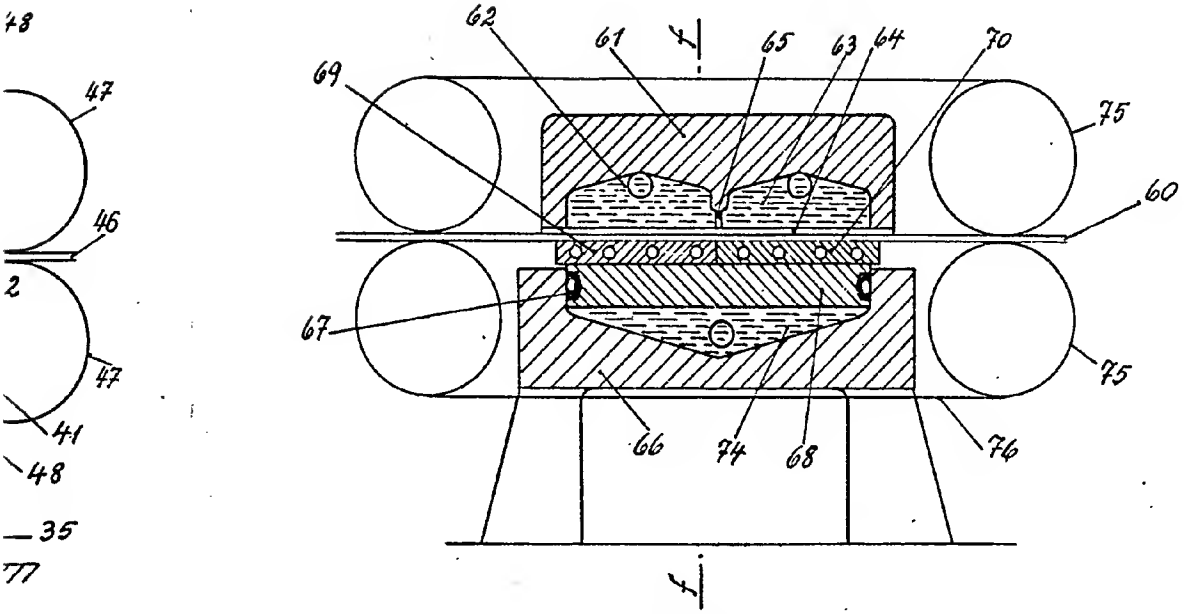
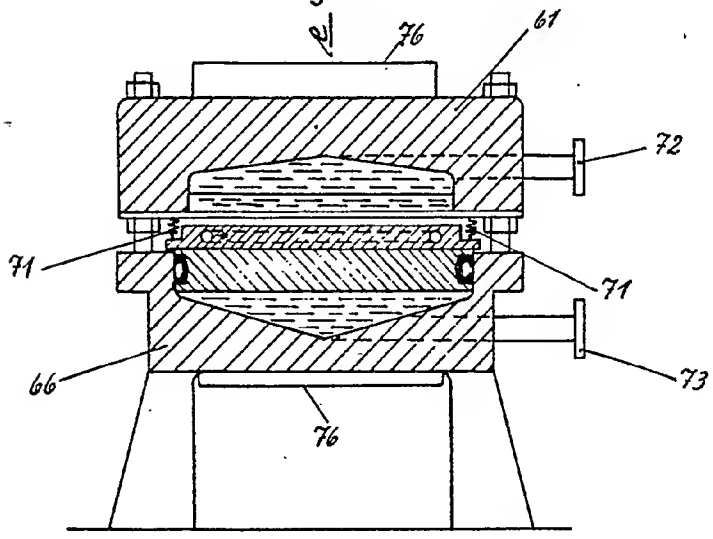


Fig. 8



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SHEETS 4 & 5

Fig. 9

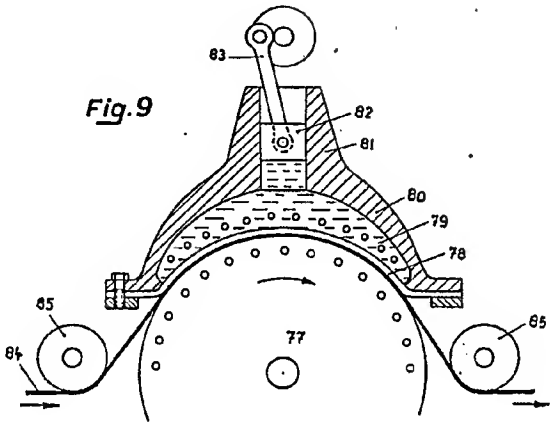


Fig. 10

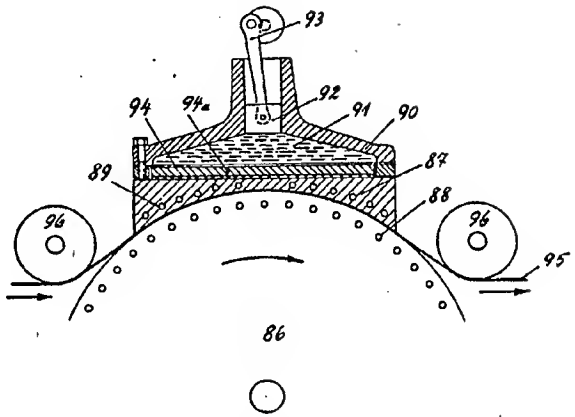


Fig. 12

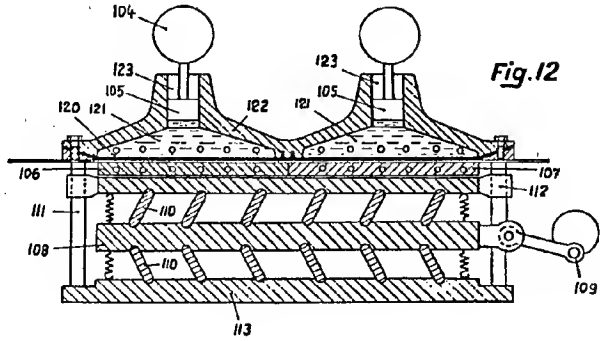


Fig. 11

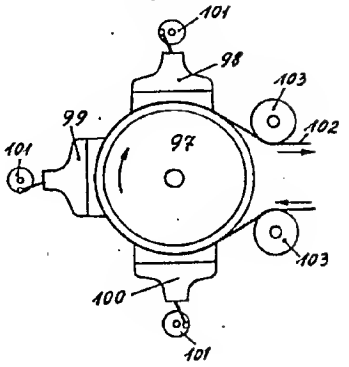
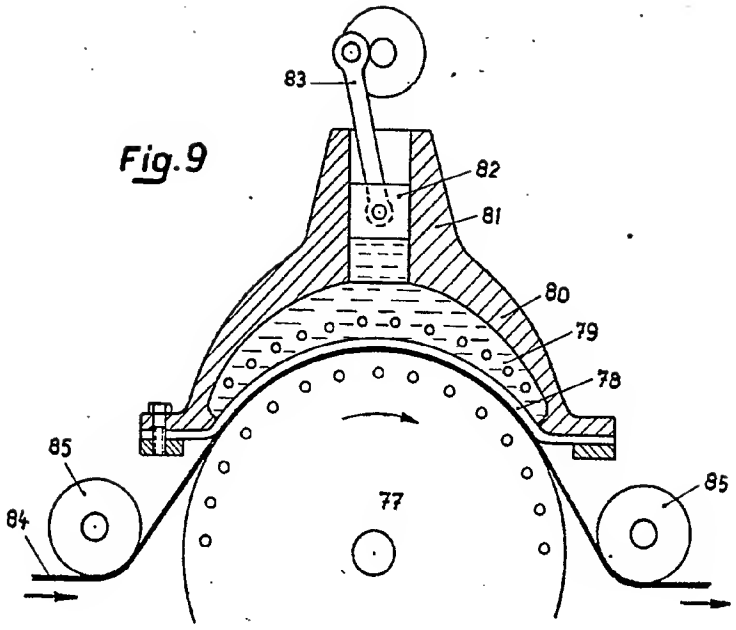


Fig.9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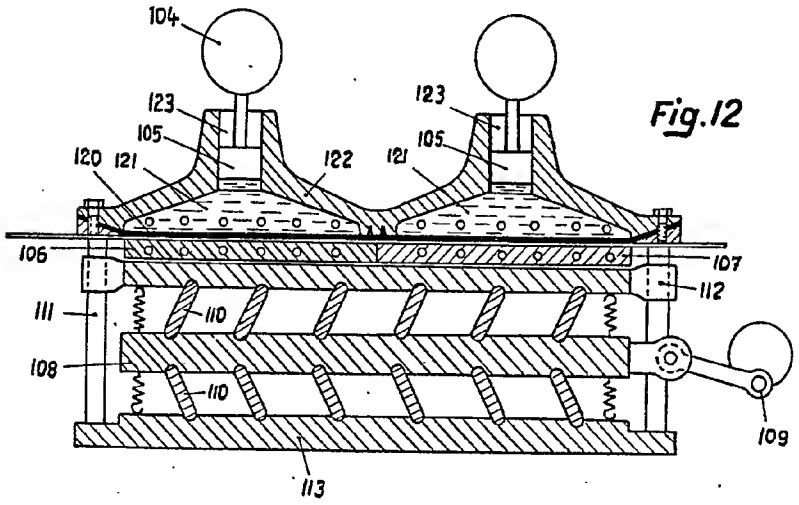
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Fig.12

708,342 AMENDED SPECIFICATION
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SHEETS 4 & 5

Fig. 10

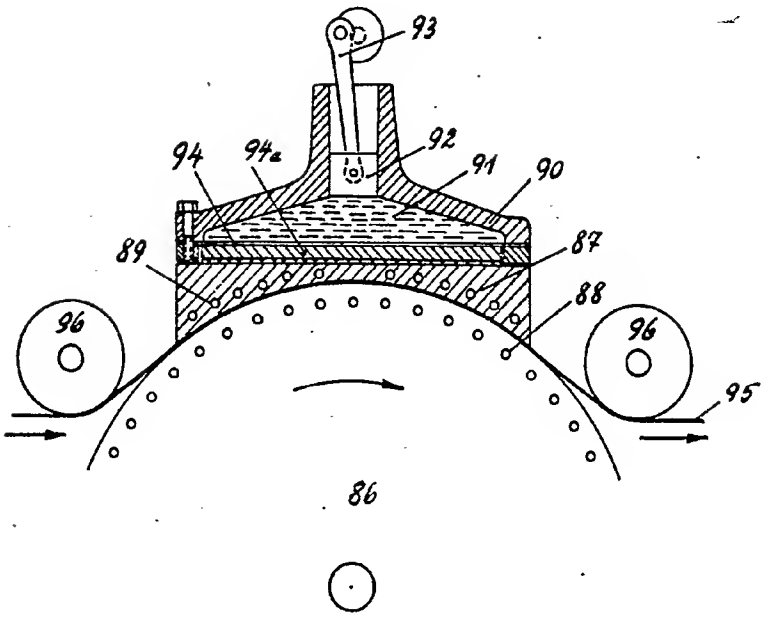
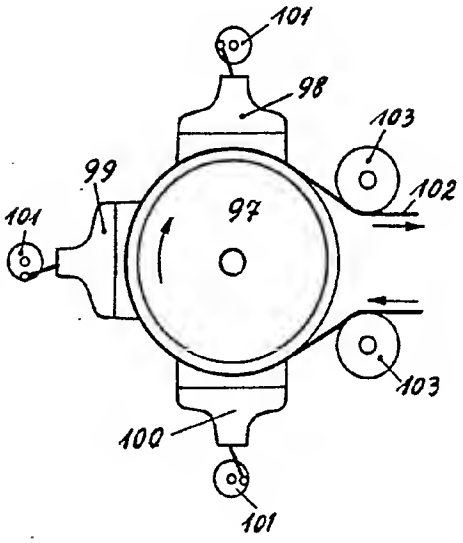


Fig. 11



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